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ABSTRACT

The 11 papers that were read at the Pittsburgh conference on the theory and practice of beginning reading are examined in this document. The papers and the state of the art are reviewed under five topical divisions, including developmental and processing stages, the nature of codes, cognitive control in reading, individual differences, and program design. The emphasis in each section is to show how research influences practical application; specifically, research can act either as a lens, to focus the problem clearly, or as a blinder, to keep the true problem from being solved. (RL)

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Applying Theories and Theorizing About Applications

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Applying Theories and Theorizing About Applications[1]

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I. A View of Application and Theory

There is a conventional wisdom about the relationship between application and theory which goes something like this. Basic scientists work out a detailed theory of how a process like reading takes place. The theory specifies the role of different variables governing the process. After basic scientists have developed their theory, practitioners can apply it--preferably with the requirement for a little creativity of their own in adapting it to young minds in large classrooms rather than college students working in individual laboratories. It is that conventional wisdom which Venezky seemed to have in mind when he lamented the difficulty of developing a really detailed account of the reading process when we are manipulating only one or two variables at a time in the laboratory. That would indeed be a staggering task when one examines a paper like Beck and Block's[2] in which literally dozens of decisions about the contents and order of aspects of lessons need be made.

It hardly needs to be said in the home city of Herbert Simon (1969) that there is a larger difference between natural science and artificial science than the conventional wisdom supposes. It is hopeless to expect that basic scientists will produce the kind of theory of reading which

would render routine the efforts of curriculum designers to produce programs which teach efficiently and motivate the children who use them. But this does not mean that basic science is irrelevant to the job of application. Rather the basic science serves both as a lens and as blinders which the practitioner may wear when he performs the complex psychological search process involved in seeking a satisfactory design.[3] Basic science theory serves to amplify those aspects of the problem with which experimental psychologists have labored. It also tends to reduce attention to other problems which may be important in design but which lack status within basic psychology.

Chall referred to these blinders when she discussed the pioneering views that Orton (1925) brought to the attention of psychologists as he sought to explain why normally intelligent children were unable to learn to read. The psychology of the time, dominated by Behaviorism and Gestalt theorists, and by psychometrics, were simply unable to assimilate to their language the observations of Orton. Thus according to Critchley (1967), "in many ways the illiterate or barely literate was looked upon as the mildest form of imbecility."

Psychology could hardly view deficit in any other way but as a generalized imperfection in mind or brain which would show up in reading as in any other task. Psychology had no language in which to discuss the difficult problems of dyslexia and thus Orton turned to neurology for a more receptive viewpoint.

We should be aware of the lenses and of the blinders which the kinds of theoretical presuppositions represented by this meeting are providing to the analysis of reading. I believe that the language which is being used at this meeting is much richer in its ability to aid the practitioner to think about and to search for the important variables in the design of curricula.

II. Developmental and Processing Stages

Two major theoretical predispositions were represented in the meeting this week. The first was presented in the keynote address by Jeanne Chall and represents a stage approach to the processes in reading (see upper panel of Figure 1). To my way of thinking it is

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Insert Figure 1 about here
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an important idea because it brings some unity to the set of problems which a designer faces in the development of a reading curriculum. For example, the fact that decoding is only the very first phase in Chall's set of stages suggests that a conference such as this one which is focussed on elementary education must also face the smooth transitions which would be necessary to allow what is learned in decoding to serve the basis of later fluency. If one viewed this conference without the material which Chall presented, one might suppose that the problem of reading was solved with decoding, where in fact only the initial stage can be solved by decoding.

The developmental stage view helps us to focus on a demand which will be of increasing importance as practitioners attempt to design new curricula. What kinds of tests would tell us whether a student has mastered some level? It is fairly easy to determine whether a student has mastered decoding because he can read aloud. How can we tell if reading is fluent, if it is fostering new learning, if it is leading to new views of the world, or if it is fostering the student's own world view? These are issues which will require new and subtle forms of diagnosis.

The Chall view is not without its blinders. One of them is most critical in understanding the controversy between Chall's position and Goodman's. I feel that the stage view of Chall begins too late. In Figure 1 (lower panel) I have included a set of stages from recent work by Rozin and Gleitman (1976). Rozin and Gleitman, like Goodman, recognize that children come into the reading situation not only with a well developed auditory language (which has been stressed at this conference) but also with highly developed visual routines which allow them to act appropriately to objects in their environment. Thus it should be no surprise that, as Goodman points out, children who do not know how to read and have never had any instruction can act quite appropriately to cans of soup and candybars. Rozin and Gleitman indicate that the visual routines that we have learned about objects lead naturally to an understanding of written language in its logographic sense. Children need no instruction to understand that visual symbols have meaning.

Rozin and Gleitman also point out that the difficult problem of reading is mastery of the peculiar alphabetic principle which is at the basis of a phonetic writing system such as ours. Thus I feel the Chall stages start too late and thus make it seem that reading as a whole is unnatural, a difficulty which is probably true of the alphabetic principle rather than of reading as a whole.

Moreover Chall's stage view might lead us to suppose that decoding is completed in the first stage. After all there is a decoding stage followed by a fluency stage. I'm sure that she would not mean to imply this, but unfortunately one of the problems of basic science theory is that the theorist never goes along with the theory to explain its full meaning. Stage views are often conceived of by readers as consisting of sets of discrete processes. Thus a reader might very well think that the decoding process ends as fluency and reading for new learning begins. But if Venezky and Massaro are right, one of the most important aspects of fluent reading does not lie in its phonetics but in its orthography. It may be that important kinds of decoding skills are being learned during and beyond the stages at which fluency is being obtained. Stage views need to be seen as involving shifts of emphasis but not as meaning that one stage ends before the next begins. I hope to have used the Chall view to illustrate for you how each basic science theory provides both lenses for the examination of issues and blinders which divert attention from some problems.

In contrast to the developmental stage view of reading, one can examine another theoretical predisposition which was strong at this meeting--the information processing view. The power of viewing reading in terms of information flow is that it forces one to view reading as a skill with much in common with other skilled performance. For example, Perfetti and Lesgold found that higher level strategies did not distinguish between good and poor readers. What did distinguish were the processes involved in perceiving a single word. This result is reminiscent of the points made by DeGroot (1965) and Chase and Simon (1974) in the study of chess. Chess masters did not differ from others in the protocols which they produced describing the reasons for their choice of moves, but they did differ in their ability to see almost immediately the organization of the chess board. A similar effect was found by Reicher and Haller (1971) to distinguish very good from mediocre sight readers of music. Although this view of reading may need to be supplemented at later developmental stages by something like Frederiksen's notion that higher level strategies also differ between good and poor readers, the Perfetti and Lesgold view suggests that in the early stages reading may be viewed like other skills.

If so, one should be able to look to selection, training and human engineering of the task as means of improving the skill. These are the methods by which psychologists have attempted to improve other types of skilled performance (Posner & Keele, 1972). An extremely important aspect of the problem of reading instruction is that we are no longer able to use

selection to choose only the people best able to learn to read. This is very unlike almost all other training that goes on in our society. Nearly any other skilled training can select those people who are most interested or most able to learn the skill. Imagine the national crisis if all Americans had to learn to draw, run the 6-minute mile, speak Italian or almost any other skill. Reading instruction is unique in that we expect every person to learn the skill. With selection out, we naturally focus, as this conference has, on training methods in an attempt to improve the skill. I will comment on these suggestions in later sections.

A third way in which other skills have been improved is to redesign the task. For example, skiing instruction has greatly been aided by the use of the short ski with transitions to longer and longer skis as the skill develops. Efforts in this direction in reading, for example ITA or fading methods discussed by Holland, have not been particularly successful. I think the reason for the failure of human engineering to improve the decoding skill is due to a failure to recognize the importance of the orthographic and visual familiarity as part of the skill of reading. While ITA aids the child in sounding out words, it may inhibit his learning the orthographic and visual codes which are going to be an important part of the later fluency stage. A similar criticism can be made of the color coding schemes discussed by Holland.

In the later stages of reading development there will be, it seems to me, greater opportunity for human engineering of the task. For example, legibility studies have already done a great deal to help us choose better column widths and type fonts. The type of work in which Frederiksen and others are engaged should also lead to new summarization devices which could aid the reader in grasping the organization of a chapter which he is about to read.

Perhaps the most important benefit in viewing reading as a skill is that the flow diagrams which have developed from the general information processing approach become available as tools to examine reading. Both Massaro and Venezky and Samuels have proposed such models. I prefer the Samuels model because it can be modified slightly, as in Figure 2, to emphasize the parallel organization of the visual and phonetic codes and because it strongly impresses upon us the importance of cognitive control by separating the attentional mechanisms from the passive abstraction of information. Cognitive control by attention has been stressed by Frederiksen and Bateman among others at this conference. It is clearly very important that issues involved in cognitive control of information flow be represented to the practitioner involved in designing reading curricula.

Although the information flow diagrams are useful in conceptualizing the reading task, they also have problems. For example, they tend to ignore the developmental stage issues which are so nicely emphasized

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Insert Figure 2 about here

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by Chall's model. Even if it is the case that the skilled reader will rely primarily upon orthographic or visual codes of stimuli rather than phonetic recoding, it still may be important, if only for reasons of motivation and independence, to start off with an emphasis on the phonetic representation. Flow diagrams, based as they are on the skilled reader, give us a language for talking about the internal processes involved in reading, but they may cause us to ignore the unique problems involved in how one gets to be a skilled reader in the first place.

III. Nature of Codes

I have already alluded to the importance of the visual configuration of the stimulus in reading. This is most clear when words are dealt with in logographic form. However, one of the most important points made at the conference is the view expressed by Massaro and Venezky that it is now possible to separate experimentally the visual code of a stimulus from its phonetic recoding. It is quite surprising that a word is chunked together as a unit within the visual system independently of its being pronounced. This chunk depends in part upon the rules which provide the orthographic regularity of the English language. It could also depend in part upon the visual familiarity which subjects have of particular combinations, even ones which are not orthographically regular, such as FBI or IBM. This point, eloquently discussed by Massaro and Venezky, means that

one cannot limit the decoding skill to the transformation of the visual array into its phonetic representation. Rather one needs to build up skills in seeing complex visual arrays as chunks. Massaro and Venezky give us no specific means for so doing, but it is clear that some methods which might be excellent for teaching phonetic representation, for example ITA, probably interfere with our ability to develop visual chunks. Lee Brooks (1976) in particular has discussed methods by which orthographic regularity might be stressed within visual presentation. Indeed even Distar, which places great emphasis upon phonetic recoding, seems to teach certain subroutines, such as scanning words visually, which might be successful ways of teaching the orthographic code.

Clearly we must find out whether learning to pronounce is a good basis for teaching orthographic codes or whether it interferes with our ability to learn the visual regularity implicit in our language. This is important because, as Baron (1973) has pointed out by showing subjects phrases like, "tie the not", we make semantic judgments not alone from phonetic codes of the stimuli but from our sense of their visual correctness.

The idea of an organized visual code and its relation to semantics was one basis for the look-say method. That method rested on an implicit assumption that visual familiarity of a letter string was the most important basis for the visual code. Recent research has suggested that orthographic regularity even of visually unfamiliar

material (e.g., GaRbAgE) is of equal or greater importance. Unfortunately we do not know the best means for teaching this code.

While it is important to put emphasis on the visual code of written language, it is still important to recognize that much initial comprehension rests upon the already developed relationship between auditory input and meaning. Sticht more than anyone else has stressed this close relationship in suggesting that we ought to look at the limits of comprehension of the child in terms of his ability to deal with auditory language. I believe that Sticht's methods are clever and ought to be used, as perhaps they already are. However, I do not believe that they will turn out as useful in the later stages of reading. Materials which can be conveyed best in the spoken language differ quite a bit from what can best be understood in the written language. Even if it turns out that in the early decoding stages of reading Sticht is correct and that we can use auditory comprehension as an upper limit for the child's ability to comprehend reading, I doubt this will be true in the later stages. Instead we will need to focus on the kinds of information which are most appropriately conveyed in the written language as Shuy suggests.

IV. Cognitive Control

One of the reasons for preferring the flow diagrams presented by LaBerge and Samuels (1974) is that they explicitly recognize

the importance of cognitive control by freeing the attentional mechanisms from a particular place in the sequence of processing and putting them essentially available to work on information in any of the codes. More than anyone else, Frederiksen outlines the importance of such an assumption. His two hypotheses emphasize the role of the subject in exercising cognitive control by developing hypotheses and inferences about what he is reading. Obviously cognitive control is increasingly important as one reaches the later stages in Chall's developmental scheme. Frederiksen proposes first that control from higher level cognitive mechanisms and formation of hypotheses is an essential characteristic of skilled reading. This hypothesis is certainly confirmed by studies which show the importance of set even on the most primitive aspects of the reading process. For example, Schindler, Well and Pollatsek (1974) have shown that , when a subject is set to expect words, he performs physical matching more efficiently for words than when he is not set to perceive words. Moreover, Hawkins, Reicher, Rogers and Peterson (1976) have also shown that when subjects have a large number of homophones in a list such that the phonetic recoding of the visual information will not be an effective strategy, they seem to adopt a visual representation rather than a phonetic one. These experimental demonstrations fit with the longstanding anecdote about the man who picked up a phone expecting to hear Russian, a language which he did not speak, and was consequently unable to understand the English that was actually

spoken. Thus there is ample evidence that even the most automatic characteristics of the reading process are influenced by cognitive control as Frederiksen's first hypothesis would suggest.

What is less well understood is the difficulty in bringing to awareness some of the automatic components involved in recognizing patterns. Experimental efforts have generally been directed to showing that some process is automatic rather than understanding the difficulty which we have in bringing to awareness some aspects of processes which are automatic. This notion has been emphasized by Gleitman and Rozin (1976) who propose a general principle to relate awareness and automatic processing:

> The child's natural history of explicit language knowledge proceeds in a sequence similar to the evolution of writing. The young child first becomes explicitly aware of meaning units, and only later becomes aware of the syntactic and phonological substrata of language. Thus it is easy for the young child to learn the principles of a script that tracks meaning directly and hard for him to acquire a script that tracks a sound system. These parallels suggest an approach to reading... It might be useful for the child to be introduced to visual language as a logography. Thereafter we suggest that the syllabic unit which maintains its shape and sequential integrity in speech perception and production may be useful for introducing the learner of an alphabet to the general class of phonographic scripts. In

this approach, the abstract phonemic (alphabetic) concepts would be introduced to the learner relatively late. Summarizing, we propose that an initial reading curriculum that essentially recapitulates the historical evolution of writing will mirror the mental linguistic development of the child.

These challenging concepts propose that it is useful in the learning process to bring to awareness the automatic characteristics which chunk individual phonemes into a complete word in the listener's awareness. In their reading curriculum, Rozin and Gleitman (1976) utilize the general principle that decoding is best taught by taking advantage of the level of processing of which the child is aware rather than at first attempting to teach the alphabetic principle. Unfortunately little evidence is yet available that producing awareness of a process is a good means of producing learning. This question raises a fundamental issue in the important and complex relationship between cognitive control and automatic processing. I believe this is one place where intensive experimental analysis on the relation of awareness and learning should be developed.

Frederiksen's work also points at important literature which is emerging in the area of semantic memory (Norman, 1973; Kintsch, 1972) which I mentioned previously as perhaps leading to an ability to apply the principles of human engineering to the design of reading materials appropriate for the later stages of development. These studies are

pointing to the types of structures which subjects produce from complex stories and other written materials. Semantic memory research shows clearly that the cognitive structures bear a complex relation to the surface stream of words actually presented. There is much room for the development of diagrams, outlining, and other techniques which will provide summaries of these structures and help us to relate the surface stream of words in reading to the underlying semantic codes of our own long term memory system. The work that has been done so far only scratches the surface of what should be a major contribution of cognitive psychology to the design of educational materials. This work relates less to the early stages of elementary school reading which we have emphasized in this conference than to the later stages of the developed reading skill at which one attempts to build the multiple and world views outlined in the Chall stages.

V. Individual Differences

There was relatively little discussion at this conference on differences among individuals. Perhaps the data reported by Bateman indicating that nearly any individual can learn to read given the proper teaching program seems at first to overcome any necessity for examining individual differences. Surely one would not wish the examination of individual differences to be used as an excuse to avoid accountability for providing the very best teaching possible

to every person. Nonetheless, from both a basic research and applied viewpoint, it is important to recognize differences among individuals. There was almost a visible unease in the conference when anyone discussed central nervous system dysfunction as a possible cause of reading disability. Fisher's efforts to do so, though very preliminary, raise difficult ethical problems in people's minds in the fear that such discussion might be used as an excuse to avoid accountability. However, we must recognize that the flow diagrams produced by information processing psychologists are, however preliminary, diagrams about how the brain is organized. We should expect that as the human goes through different developmental stages and learns different new things, brain organization changes. We should not get in the habit of thinking that the organization of the brain is something innate and fixed in time. Teaching does reprogram the brain. It provides new organization, information flow, and new temporal patterns. Thus that individuals differ in brain processes should not necessarily be thought to imply that such differences are immutable.

With this caution in mind we should recognize, as Fisher points out, that some dyslexics have specific problems in the processing of information which might arise from a variety of different systems. Work on dyslexics by Marshall and Newcombe (1973), Shallice and Warrington (1975) and Sasanuma (1974) have shown that brain damage yields different syndromes and specific disorganizations of the reading

process. Indeed Sasanuma has shown that one sort of brain damage can interfere with reading of the kana or phonetic characters of the Japanese language, while another kind disturbs the kanji or logographic characters. These findings are consistent with the different systems pointed out in the flow diagrams illustrated in Figure 2. We should expect, and indeed data suggest, that within the normal range there are vast differences in the way in which individuals orient to language. Recently Baron and Strawson (1976) have pointed out a distinction between subjects who have great difficulty in detecting spelling mistakes but do very well in decoding words that sound like familiar English (Phoenicians), and subjects who detect spelling errors easily but are not good at sound tasks (Chinese). Work by Hawkins, Reicher, Rogers and Peterson (1976) suggests that the same subject can switch strategies between different codes of the stimulus from time to time. Thus we might find both individual differences and intra-individual differences to be important in the codings involved in reading. These findings are important because they suggest reading may be done in fundamentally different ways.

We will need to try to use our knowledge of individual differences to develop tests which will be appropriate to the particular coding which complements an individual's style of learning. Some ideas concerning appropriate tests were mentioned briefly by Sticht, Perfetti and Lesgold, and Frederiksen. All of them suggest probes which

might help the teacher understand what is going on in the mind of the student as he proceeds through various aspects of the curriculum.

VI. Program Design

In these remarks I have tried to view theory as a lens and also as a blinder which when worn by the programmer or curriculum designer helps him make the many decisions necessary to develop a curriculum. Obviously basic researchers need to provide the programmer with cues as to the directions he ought to search in trying to make the complex decisions necessary to produce a full curricular design. Both stage theories and information flow theories provide some direction for programmers about the crucial decisions they might make in any particular curriculum.

Second, theory should provide teachers a language in which to discuss problems of reading. It does little good to say that someone cannot read because he is deficient. But when one starts to talk about the specific difficulty of a given person, one can begin to find ways around that difficulty. Many of the papers presented here may be seen as providing languages for the teachers to talk more completely about the complex problems which individual children have in finding their way through a curriculum.

Finally, a most important role of theory may eventually be to provide the student himself with more control over his own learning. One of the most important facts uncovered by psychology is the difficulty

which any individual has in gaining insight into his own mental structures and information processing activities. Although introspection provides powerful entry into some aspects of our own internal mental life, we cannot introspect the analyses which have been presented at this meeting. Perhaps one of the most important roles for psychology in the teaching of reading is for children themselves to learn something more about what's going on inside their heads as they learn the skill. This new insight may provide both motivation and some degree of self-direction over the course of a child's reading. This self-control is obviously more important in the later of the Chall stages than in the earlier, but it is a direction towards which psychologists should aspire as more is known about the internal processes involved in cognition. Self-control is undoubtedly the most important control mechanism which can be used to insure the learning of reading. For, after all, it will not be easy or perhaps even possible to teach to people what they do not wish to learn.

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Footnotes

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[2] Citations without specific reference dates are to contributors to this volume.

[3] For a description of the psychology involved in this kind of problem solving task see Simon (1969).

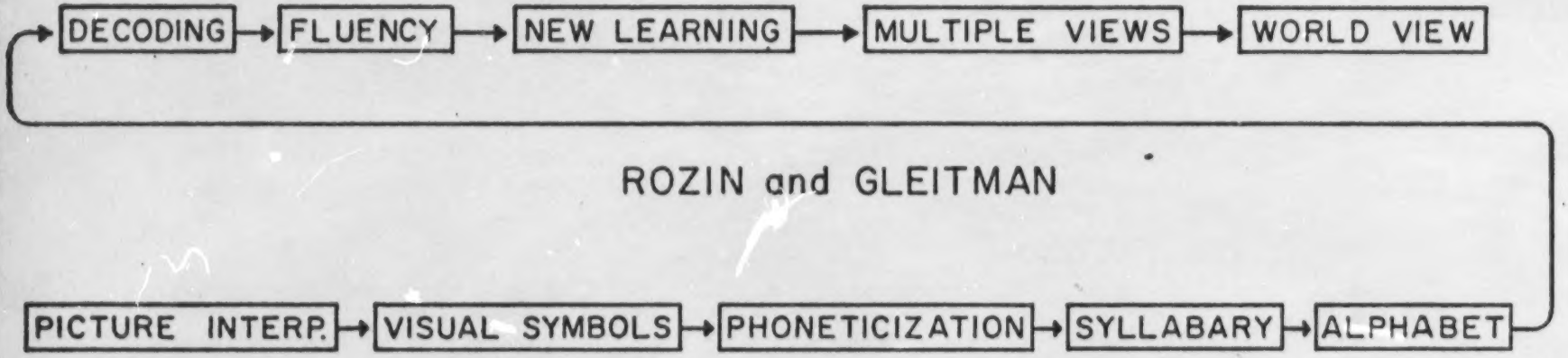
Figure Captions

Figure 1. Development stages in reading. Upper panel extracted from Chall's contribution to this volume; lower panel extracted from Rozin and Gleitman (1976).

Figure 2. Adaptation of the reading model developed by LaBerge and Samuels (1974).

DEVELOPMENTAL STAGES

CHALL'S STAGES



ROZIN and GLEITMAN

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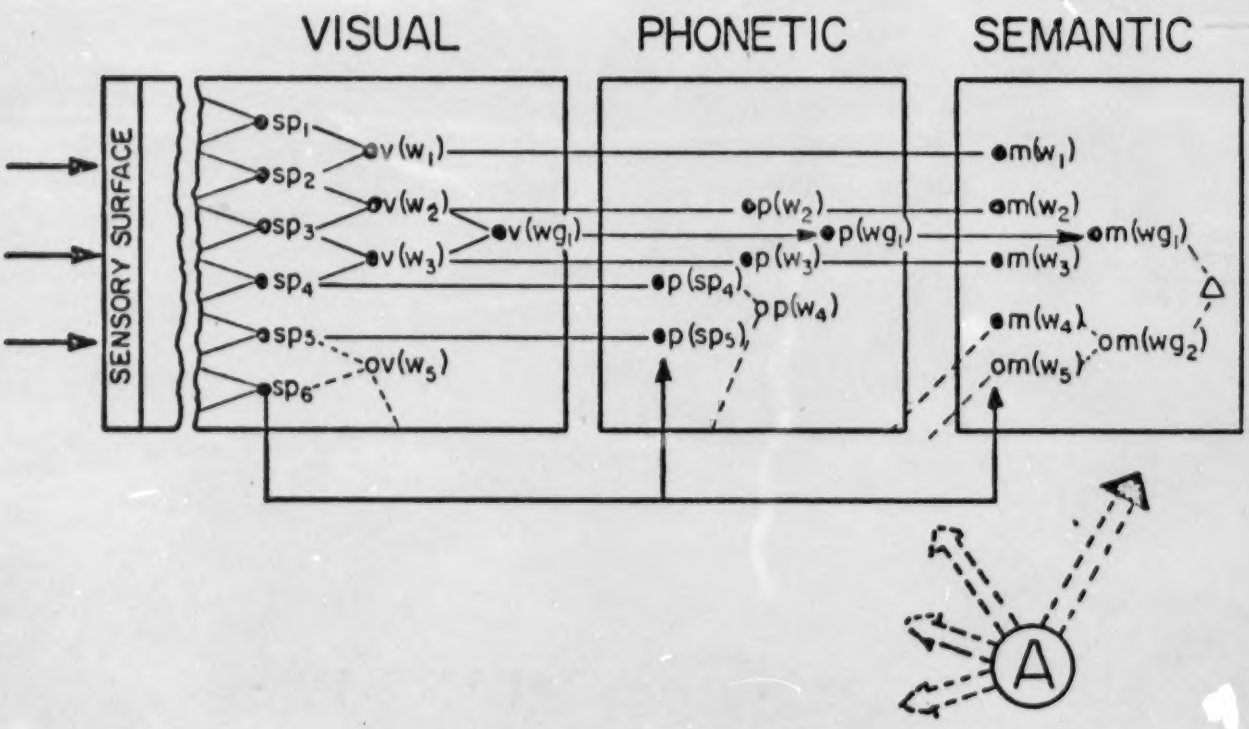
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